Agrammatic aphasics do not exhibit a normal pattern of verb production; their spontaneous speech is said to lack verbs, and the verbs that are produced lack inflection. The current article focuses on the lexical, morphological, and syntactic aspects of verbs in spontaneous speech of a group of Dutch agrammatic speakers. Dutch is a so-called verb-second language in which the finite verb in the matrix clause is in the second position and nonfinite verbs are in the final position. The analysis shows that agrammatic speakers are sensitive to this relation; they virtually never produce finite verbs in the final clause position or nonfinite verbs in the second position. Nevertheless, they produce significantly fewer finite clauses than do non-brain-damaged speakers. The diversity of the lexical verbs in spontaneous speech is also lower than in non-brain-damaged speakers, but this is due to less variation in the finite lexical verbs. Hence, it is suggested that the problems with verbs in Dutch agrammatic spontaneous speech are restricted to finite lexical verbs. In an experiment, it was evaluated whether these problems with finite lexical verbs are caused by a morphological deficit or a syntactic deficit. The data show that a syntactic deficit is more likely; Dutch agrammatic speakers produce finite verbs in the base-generated position (i.e., in the embedded clause) significantly better than finite verbs that have been moved to the second position (i.e., in the matrix clause). From these data, the authors conclude that in Dutch, a verb-second language, agrammatic aphasics demonstrate specific problems with moved finite verbs, although they are perfectly aware of the relation between verb position and verb finiteness. This syntactic problem affects not only the proportion of finite verbs but also the diversity of the verbs and, hence, communicative contents.

INTRODUCTION

A number of studies have been published regarding the nature of the problems with verbs as encountered by agrammatic Broca’s aphasics. Several studies reveal that Broca’s aphasics are poor in action naming compared to object naming (Basti-
that they produce a relatively small number of verbs in spontaneous speech (Saffran,
Berndt, & Schwartz, 1989; Thompson, Shapiro, & Schendel, 1995), and that the verbs
that are produced often lack inflection (Bastiaanse & Jonkers, 1998; Saffran et al.,
1989; Thompson et al., 1994). Most studies on the grammatical aspects of verb pro-
duction in Broca’s aphasia have been done in English, which is not the most suitable
language for such research because the inflectional paradigm is very limited and there
is little variation in the position of the verb. When one looks at verb production in
sentence context in other languages such as Hebrew (Friedmann, 2000; Friedmann &
Grodzinsky, 1997) or Hungarian (Kiss, 2000), interesting patterns emerge. Friedmann
and Grodzinsky (1997) and Friedmann (2000) showed that Hebrew agrammatics
make more errors with inflection for tense than with inflection for agreement, and
Kiss (2000) showed that in Hungarian the amount of grammatical information that
the verb contains influences the ability to produce it in sentence context; the more
grammatical roles belong to the verb and the more morphological information, the
more difficult it is to retrieve the verb in sentence context. These studies used tests
to elicit verbs. In a study of Dutch, Bastiaanse and Jonkers (1998), however, showed
that there was no relation between a patient’s ability to retrieve verbs in a single-
word task or a task for verb retrieval in sentence context, on the one hand, and his
ability to retrieve verbs in spontaneous speech. This was caused by the large variation
between patients that showed, however, a striking pattern: Patients who were rela-
tively good in verb retrieval in spontaneous speech were relatively poor in producing
finite clauses and vice versa. This was interpreted as the consequence of a trade-off
effect, although it was assumed that the underlying disorder was a grammatical one;
that is, the problems were suggested to result from an inability to produce finite
clauses. If the patients focus on producing finite clauses, then this was directly at the
cost of lexical retrieval. Bastiaanse and Jonkers (1998) suggested that these problems
were caused by a syntactic disorder rather than a morphological disorder. To under-
stand why they assumed this, a little guidance on Dutch grammar is needed.

Verbs in Dutch

Dutch has been analyzed as an SOV language, meaning that the base-generated
position of the verb is after the object (Koster, 1975). In the Dutch declarative matrix
sentence, the finite verb has to be moved to the second position. This movement is
known as verb second. This means that in a Dutch declarative sentence, the finite
verb is always in the second position, either after the subject or after another topi-
calized argument or adjunct. In case of topicalization, the subject directly follows
the finite verb. If the main verb clusters with a modal verb or auxiliary, then the
main verb remains in situ and the modal verb or auxiliary is moved to the verb-
second position. In embedded clauses, the finite verb remains in its base-generated
position. This is illustrated in (1) to (3), where t designates the canonical verb posi-
tion, which is co-indexed with the verb-second position.

(1) Matrix sentence without modal verb/auxiliary:
\[ \text{de jongen} \quad \text{koopt} \quad \text{een fiets} \quad t, \]
the boy buys a bike

(2) Matrix sentence with modal verb:
\[ \text{de jongen} \quad \text{wil} \quad \text{een fiets} \quad \text{kopen} \quad t, \]
the boy wants a bike (to buy

(3) (the boy wants to buy a bike)
Embedded clause without modal verb/auxiliary:

\[ (ik \text{ denk}) \quad dat \quad de \text{ jongen} \quad een \text{ fiets} \quad koopt \]

(I think) that the boy a bike buys

Here it is assumed that a verb is inserted in the structure in fully inflected form (Chomsky, 1995; for Dutch syntax, see Zwart, 1993). In the embedded clause, the finite verb remains in its base-generated position; in matrix clauses, only the finite verb moves to the left and the nonfinite verb stays behind. Figure 1 shows how this is represented in Chomsky’s government and binding (GB) theory.

The Relation between Verb Inflection and Verb Position in Broca’s Aphasia

Bastiaanse and Van Zonneveld (1998) presented two studies on the relation between verb position and verb inflection. First, they analyzed the spontaneous speech of three agrammatic Broca’s aphasics and showed that all nonfinite verbs were in the clause final position, the finite verbs in the matrix clauses were in the second position, and the finite verbs in the (hardly occurring) embedded clauses were in the final position with one exception. On the basis of these data, Bastiaanse and Van Zonneveld suggested that although agrammatic Broca’s aphasics produce a relatively high number of nonfinite clauses, they are sensitive to the relation between finiteness and verb position; if they produce finite verbs, then they always ‘move’ them correctly to the verb-second position, and if they do not inflect the verb for agreement and tense, then they leave the nonfinite verb in its base-generated position (i.e., clause final). This raised the question of whether the problems with finite verbs were syntactic or morphological in nature. Finite verbs in matrix clauses (and these are virtually the only finite verbs that are produced) are supposed to be moved from their base-generated position—a syntactic operation—and are inflected for agreement and tense—a morphological operation. To find this out, Bastiaanse and Van Zonneveld developed a test in which the patient was asked to fill in a missing verb in a (matrix or embedded) sentence. For example, a picture was presented of a farmer milking a cow, and a written sentence was shown: *de boer . . . de koe:* the farmer . . . the cow; for the embedded condition, the following construction was used: *Ik zie dat de boer de koe . . . ;* I see that the farmer the cow . . . ; I see that the farmer the cow . . . (target *melkt*: milks). The same design was used for eliciting infinitives: *het meisje wil op de stoep . . . :* the girl wants on the pavement . . . and *ik zie dat het meisje op de stoep wil . . . :* I see that the girl wants on the pavement to . . . (target *fietsen*: to bike). Ten agrammatic Broca’s aphasics were tested, and the results were clear: In the conditions with the verb in the clause final positions, the patients performed significantly better than in the condition with the verb in the verb-second position. The significant difference between finite verbs in the second and base-generated positions made the authors suggest that the underlying problems with finite verbs are syntactic in nature and not morphological. Agrammatic Broca’s aphasics are perfectly able to produce finite verbs (once the correct lexical form has been retrieved) so long as these verbs have not been moved from their original position.

The final conclusion from Bastiaanse and Van Zonneveld (1998) was that the basic problem with the production of verbs in sentences and spontaneous speech in Dutch agrammatic Broca’s aphasia is verb second. If, however, Dutch Broca’s aphasics do produce finite verbs in the matrix clause, then it is always in the verb-second position. Apart from that, nonfinite verbs are never produced in the verb-second position but remain at their base-generated position, which is clause final. This implied, according to the authors, that the basic problem was a syntactic one, not a morphological or lexical one.
FIG. 1. Graphical representation of three Dutch sentence types: a matrix clause with an auxiliary (left), a matrix clause with a finite lexical verb (middle), and an embedded clause (right).
These findings are compatible with theories on functional projection in aphasia, like the ones from Hagiwara (1995) and Friedmann and Grodzinsky (1997); Positions high in the syntactic tree are difficult to realize for agrammatic speakers.

There are some drawbacks to these conclusions that were brought to our attention, and these made us decide to elaborate on the studies mentioned above. In the current article, two studies are presented: one on the spontaneous speech of agrammatic Broca’s aphasics and one experiment. Both studies focus on the production of finite verbs.

The question with regard to the first study (Bastiaanse & Jonkers, 1998) is whether the use of finite clauses decreases in the diversity of lexical verbs in general or only in the diversity of the verbs that are used in their finite form. It is conceivable that verb retrieval is affected only by syntactic problems if syntactic operations have to be performed with the verb, whereas those verbs that do not undergo such a syntactic operation will be easier to retrieve.

For the second study, evaluating the relation between finite verbs and verb position in spontaneous speech, the database was very small \((N = 3)\). We decided to do a new study on the relationship between finite verbs, verb position, and lexical retrieval in spontaneous speech on a larger scale. In the former study, we used diversity (i.e., a type–token ratio) of the lexical verbs to reflect the ability to retrieve verbs. For the current study, we included a second variable that might reflect lexical retrieval abilities: word frequencies of the verb. It has repeatedly been shown that lexical retrieval of verbs is not influenced by word frequency on action naming, but it may very well be the case that word frequency of the verbs does play a role in spontaneous speech.

To establish deviations in the spontaneous speech of the agrammatic Broca’s aphasics, a comparison was made with the speech of non-brain-damaged speakers.

A serious objection to the experiment concerning the relation between verb position and finiteness (Bastiaanse & Van Zonneveld, 1998) is that the results might be an artifact. Notice that four conditions were compared—one with verb movement (filling in a finite verb in the second position) and three without verb movement (completing a sentence with a finite or nonfinite verb)—and that the one with verb movement was significantly more difficult than the ones without verb movement (the latter showing no mutual significant differences). This was interpreted by the authors as support for the hypothesis that verb movement is difficult for agrammatic Broca’s aphasics, but it might as well be influenced by a nonlinguistic factor; that is: Sentence completion is easier than inserting a word into a sentence. Although there is no a priori reason why this should be the case, a new experiment was designed in which the patient had to complete either a matrix clause with a moved finite verb and its object or an embedded clause with an object followed by a base-generated finite verb. If it is shown that, again, the embedded clause with the nonmoved verb is easier, this is strong support for the hypothesis that verb movement is at stake here.

With these extra analyses, we hope to support our claim that the central problem in the production of verbs by agrammatic Broca’s aphasics is syntactic in nature.

**METHODS**

**Spontaneous Speech Analysis**

*Subjects.* A total of 14 agrammatic Broca’s aphasics\(^2\) (mean age 57.8 years) participated in this study. The aphasia type was established with the ALLOC scores of the Aachen Aphasia Test (Graetz, De Bleser, & Willmes, 1992) and confirmed by the speech therapist who treated the patient and one of

\(^2\) The spontaneous speech samples of 14 agrammatic Broca’s aphasics have been analyzed, 13 with regard to verb position and 8 with regard to the relationship between finiteness and lexical diversity. From this latter group, 7 samples were also analyzed for verb position and 1 was not.
### Patient Data of the Study on Spontaneous Speech

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (years)</th>
<th>Gender</th>
<th>Etiology</th>
<th>Months post-onset</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>53</td>
<td>Male</td>
<td>CVA left hemisphere</td>
<td>12</td>
</tr>
<tr>
<td>B2</td>
<td>62</td>
<td>Male</td>
<td>CVA left hemisphere</td>
<td>56</td>
</tr>
<tr>
<td>B3*</td>
<td>54</td>
<td>Male</td>
<td>CVA left hemisphere</td>
<td>34</td>
</tr>
<tr>
<td>B4*</td>
<td>71</td>
<td>Male</td>
<td>CVA right hemisphere</td>
<td>9</td>
</tr>
<tr>
<td>B5*</td>
<td>66</td>
<td>Male</td>
<td>CVA left hemisphere</td>
<td>37</td>
</tr>
<tr>
<td>B6</td>
<td>38</td>
<td>Female</td>
<td>CVA left hemisphere</td>
<td>154</td>
</tr>
<tr>
<td>B7*</td>
<td>43</td>
<td>Female</td>
<td>CVA left hemisphere</td>
<td>?</td>
</tr>
<tr>
<td>B8*</td>
<td>47</td>
<td>Male</td>
<td>CVA left hemisphere</td>
<td>38</td>
</tr>
<tr>
<td>B9</td>
<td>72</td>
<td>Male</td>
<td>CVA left hemisphere</td>
<td>89</td>
</tr>
<tr>
<td>B10*</td>
<td>78</td>
<td>Female</td>
<td>CVA left hemisphere</td>
<td>29</td>
</tr>
<tr>
<td>B11</td>
<td>45</td>
<td>Male</td>
<td>CVA left hemisphere</td>
<td>77</td>
</tr>
<tr>
<td>B12</td>
<td>65</td>
<td>Male</td>
<td>CVA left hemisphere</td>
<td>5</td>
</tr>
<tr>
<td>B13*</td>
<td>43</td>
<td>Male</td>
<td>CVA left hemisphere</td>
<td>12</td>
</tr>
<tr>
<td>B14*</td>
<td>63</td>
<td>Female</td>
<td>CVA left hemisphere</td>
<td>125</td>
</tr>
</tbody>
</table>

* Patient participated only in the study on the relation between finiteness and verb diversity.

* Patient participated only in the study on the relation between finiteness and verb position.

The authors (R.B.). All patients spoke in so-called telegraphic speech. Of the patients, 13 were right-handed and aphasic due to a single stroke in the left hemisphere, and 1 was left-handed and aphasic due to a stroke in the right hemisphere. The relevant data are given in Table 1. Of these 14 patients, 8 participated in an earlier study (Bastiaanse & Jonkers, 1998) that showed poor finiteness and poor diversity of lexical verbs. The aim of the current study was to find out whether this was due to low diversity of verbs in general or to low diversity of only the finite verbs, and this was done only for these 8 patients because they were the only ones who produced sufficient spontaneous speech for a reliable lexical analysis (>300 words). For comparison, a new group of 8 non-brain-damaged speakers was recruited, and their spontaneous speech was analyzed in the same way. This group was composed of subjects who matched an average group ofgrammatic Broca’s aphasics on age, gender, and education.

**Materials.** From each patient, a sample of spontaneous speech was available in which the patient answered questions such as “Can you tell me how your speech problem started?” “Can you tell me something about your hobbies?” and “Can you tell me about the work you used to do?” To obtain samples that were comparable with respect to verb tense, the healthy speakers were asked about their last illnesses, their previous jobs, and their hobbies. All interviews were audiotaped and transcribed orthographically.

**Analysis.** For the agrammatic aphasics, each lexical verb, auxiliary, copula, and modal verb was counted and scored on whether it was finite or nonfinite (infinitives and participles) and on whether it was in the verb second or final position.

For the rest of the analyses, the data of the agrammatic aphasics were compared to those of non-brain-damaged speakers, and therefore a fixed sample size of 300 words was used. The samples of 8 of the patients contained sufficient spontaneous speech to be included in this second analysis. All (finite and nonfinite) lexical verbs, auxiliaries, copulas, and modals were counted, and the following categories were distinguished: finite verbs (containing lexical verbs, copulas, modals, and auxiliaries), nonfinite verbs (infinitives and participles), and number of clauses containing more than one of these classes (e.g., the boy *has eaten* the banana: auxiliary + participle; the man will go home: modal + infinitive).

From each clause containing a lexical verb, auxiliary, copula, or modal, it was established whether it was finite or nonfinite. The number of finite clauses was divided by the total number of clauses con-

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3 A sample size of 300 words is sufficient for a reliable grammatical and lexical analysis (see Brookshire & Nicholas, 1994; Vermeulen, Bastiaanse, & van Wageningen, 1989).

4 Unlike English, there is a difference in the past tense and the participle in Dutch; Dutch does not use the progressive form such as *going* and *eating*.)
TABLE 2
Patient Data of the Experimental Study

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (years)</th>
<th>Gender</th>
<th>Etiology</th>
<th>Months post-onset</th>
</tr>
</thead>
<tbody>
<tr>
<td>B15</td>
<td>27</td>
<td>Female</td>
<td>CVA left hemisphere</td>
<td>60</td>
</tr>
<tr>
<td>B16</td>
<td>44</td>
<td>Female</td>
<td>CVA left hemisphere</td>
<td>17</td>
</tr>
<tr>
<td>B17</td>
<td>38</td>
<td>Female</td>
<td>CVA left hemisphere</td>
<td>62</td>
</tr>
<tr>
<td>B18</td>
<td>53</td>
<td>Female</td>
<td>CVA left hemisphere</td>
<td>3</td>
</tr>
<tr>
<td>B19</td>
<td>67</td>
<td>Male</td>
<td>CVA left hemisphere</td>
<td>66</td>
</tr>
<tr>
<td>B20</td>
<td>50</td>
<td>Female</td>
<td>CVA left hemisphere</td>
<td>3</td>
</tr>
</tbody>
</table>

taining a lexical verb, auxiliary, modal, or copula. This resulted in the so-called finiteness index: the proportion of finite clauses. Apart from this, it was analyzed whether the finiteness of a clause was expressed with a finite verb or with a copula, auxiliary, or modal.

As a measure of lexical–semantic content, the diversity of the verbs was considered to be most suitable, and therefore a type–token ratio was used: the number of different lexical verbs (types) divided by the total number of lexical verbs (tokens). This was done for all of the lexical verbs together and for the finite and nonfinite lexical verbs separately. To find out the influence of word frequency, for each of the verbs produced by the Broca’s aphasics and the healthy subjects, the word frequency was established according to the norms of the CELEX database (Burnage, 1990). For each subject, the mean logarithmic frequency of the produced lexical verbs was calculated (the frequencies are per type, not per token).

Sentence Completion Test

Subjects. A total of 6 agrammatic Broca’s aphasics participated in this study. None of these patients participated in the former study. The selection criteria were exactly the same as mentioned above. The relevant data are given in Table 2.

Materials. The patients were presented with two pictures in which the same person was performing the same action with a different person or object. The patient was asked to complete a sentence. There were two conditions: (a) a matrix clause that should be completed with a finite verb–object (the +movement condition) and (b) an embedded clause with the intended answer object–finite verb (the –movement condition). There were 15 sentences in each condition. Two examples follow (see Fig. 2).

Condition 1: target = finite verb–object:
Tester: *Dit is de man die de tomaat snijdt en dit is de man die het brood snijdt. Dus deze man snijdt de tomaat en deze man . . . [Patient: *snijdt het brood]*
Literal translation:
Tester: This is the man who the tomato cuts and this is the man who the bread cuts. So, this man cuts the tomato and this man . . . [Patient: cuts the bread]

Condition 2: target = object–finite verb:
Tester: *Deze man snijdt de tomaat en deze man snijdt het brood. Dus dit is de man die de tomaat snijdt en dit is de man die . . . [Patient: *het brood snijdt]*
Literal translation:
Tester: This man cuts the tomato and this man cuts the bread. So, this is the man who the tomato cuts and this is the man who . . . [Patient: the bread cuts]

In Fig. 3 the syntactic trees of these sentences are shown. Each set of pictures was used two times: once with a matrix clause and once with an embedded clause to complete. A complete list of the items is given in Appendix A. The test started with two examples that were repeated until it was clear that the patient understood the task.

The reason to prompt the patient with the verb and the noun several times before he or she was supposed to produce it was to avoid interference with word-finding problems. After the test was con-

5 For this experiment, 8 agrammatic Broca’s aphasics have been tested. One of them made no errors at all (patient discussed by Kolk, 1999), and another did none of the items correctly (if he produced an answer, it was either the verb or the object noun but never more than one word). These patients have been excluded because they cannot contribute to whatever pattern will be found.
FIG. 2. An example of the pictures used in the test.

structured, it was presented to 3 healthy speakers, who had no problems with any of the items (all scored 100% correct). For a different study on language acquisition, the test has also been presented to 10 8-year-old children, who performed faultlessly. Therefore, all of the errors that the agrammatic aphasics made were supposed to result from their aphasia and not from test construction.

Scoring. A simple correct/incorrect scoring system was used in which determiner omission was ignored. Self-corrections were allowed, and the final answer was the one that was analyzed. If requested, the examiner repeated the cueing sentences one time. Post hoc, an error analysis system was developed

FIG. 3. The syntactic trees of the sentence types used in the test.
TABLE 3
Position of the Finite and Nonfinite Verbs in the Utterances of the Agrammatic Speakers (N = 12)

<table>
<thead>
<tr>
<th>Verb position</th>
<th>Finite</th>
<th>Nonfinite</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>244</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2(9)†</td>
<td>119</td>
</tr>
</tbody>
</table>

† In total, 9 finite verbs are in the clause-final position, but 7 of these are in the embedded clause, so the final position is the correct position.  
‡ In total, 13 nonfinite verbs are not in the final position; 11 of these are not in the verb-second position but are (legally) followed by an adjunct (e.g., heeft huis gekocht in Amsterdam [has house bought in Amsterdam]).

on the basis of the most frequently occurring errors: verb omissions, inversion of finite verb and object, and a class “others” that contained semantic paraphasias, no responses, and so on.

RESULTS

Spontaneous Speech Analysis

The results of the spontaneous speech analysis are mentioned in Table 3 (the individual figures are given in Appendix B). The data show that agrammatics are sensitive to the relation between finiteness and verb position. Only 4 of 385 (1.04%) are not in their proper position. Only 2 (0.78%) finite verbs (including auxiliaries, modals, and copulas) have not been raised to the second position in the matrix clause, and only 2 (1.5%) nonfinite verbs have been illegally raised to the second position. In Table 4, the results are given for the finite–nonfinite analysis (the individual data are given in Appendix C). When the finite and nonfinite clauses⁶ are compared, it

TABLE 4
The Raw Numbers of the Verb Forms Produced by the Agrammatic and Non-Brain-Damaged Speakers

<table>
<thead>
<tr>
<th></th>
<th>Agrammatics (n = 8)</th>
<th>Controls (n = 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total finite verbs</td>
<td>208*</td>
<td>318</td>
</tr>
<tr>
<td>Finiteness index (mean)</td>
<td>0.72*</td>
<td>0.96</td>
</tr>
<tr>
<td>Lexical verbs</td>
<td>107 (.51)</td>
<td>141 (.44)</td>
</tr>
<tr>
<td>Copulas</td>
<td>45 (.22)</td>
<td>65 (.20)</td>
</tr>
<tr>
<td>Modals</td>
<td>24 (.12)</td>
<td>42 (.13)</td>
</tr>
<tr>
<td>Auxiliaries</td>
<td>32* (.15)</td>
<td>70 (.22)</td>
</tr>
<tr>
<td>Total nonfinite verbs</td>
<td>126</td>
<td>186</td>
</tr>
<tr>
<td>Infinitive</td>
<td>110* (.87)</td>
<td>62 (.33)</td>
</tr>
<tr>
<td>Participles</td>
<td>16* (.13)</td>
<td>124 (.67)</td>
</tr>
</tbody>
</table>

Note. Proportions of the verb forms on the total numbers of finite and the total numbers of nonfinite verbs are in parentheses.  
* p < .05.

⁶ Notice that in our method, a clause contains a verb by definition, meaning that utterances containing no verb, copula, modal, or auxiliary have not been analyzed.
TABLE 5
The Results of the Lexical Analysis of the Spontaneous Speech

<table>
<thead>
<tr>
<th></th>
<th>Agrammatics (n = 8)</th>
<th>Controls (n = 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of verbs</td>
<td>29.10</td>
<td>31.50</td>
</tr>
<tr>
<td>Type–token ratio verbs</td>
<td>0.51*</td>
<td>0.65</td>
</tr>
<tr>
<td>Type–token ratio finite verbs</td>
<td>0.52*</td>
<td>0.72</td>
</tr>
<tr>
<td>Type–token ratio nonfinite verbs</td>
<td>0.62</td>
<td>0.74</td>
</tr>
<tr>
<td>Frequency of verbs</td>
<td>2.60</td>
<td>2.58</td>
</tr>
<tr>
<td>Frequency of finite verbs</td>
<td>2.98</td>
<td>2.83</td>
</tr>
<tr>
<td>Frequency of nonfinite verbs</td>
<td>2.35</td>
<td>2.54</td>
</tr>
</tbody>
</table>

* p < .05.

shows that the proportion of clauses containing a finite verb (including auxiliaries, modals, and copulas) is reduced; the finiteness index of the agrammatics is significantly lower than normal \((z = -2.95, p = .003)\). The non-brain-damaged speakers also produce significantly more finite verbs (including auxiliaries, modals, and copulas) than do the agrammatic speakers \((z = -3.15, p = .002)\). The numbers of finite lexical verbs \((z = -1.48, p = .140)\), copulas \((z = -1.80, p = .073)\), and modal verbs \((z = -1.66, p = .096)\) are not significantly lower (although there is a trend for the copulas and modals), but non-brain-damaged speakers produce significantly more auxiliaries than do agrammatic speakers \((z = -2.27, p = .023)\). The total number of nonfinite verbs is not significantly different between the groups \((z = -0.79, p = .429)\). This is a bit misleading, however; non-brain-damaged speakers produce significantly more participles \((z = -2.72, p = .007)\) but significantly fewer infinitives \((z = -2.007, p = .045)\). In sum, the agrammatic speakers produce significantly fewer finite verb forms, including auxiliaries, modals, and copulas, mainly due to a low number of auxiliaries.

In Table 5, the results of the lexical analysis are presented. The total number of lexical verbs produced by the agrammatics is normal, but the diversity, as measured by the type–token ratio, of the lexical verbs is significantly lower than in normal speech \((z = -2.00, p = .045)\). When the type–token ratios for finite and nonfinite verbs are analyzed separately, it shows that this is due to the low diversity of the finite verbs \((z = -2.107, p = .035)\); the diversity of the nonfinite verbs is normal \((z = -1.05, p = .294)\). No differences were found for the frequency of the verbs produced \((z = -0.42, p = .674)\) of neither of the nonfinite verbs \((z = -0.63, p = .529)\) nor of the finite verbs \((z = -1.50, p = .294)\).

In summary, agrammatic Broca’s aphasics are sensitive to the relation between verb position and verb finiteness in that they virtually never produce a verb form in a wrong position. Finite forms are difficult to produce for them; not only do they produce a lower proportion of finite clauses, but the variability of the finite lexical verbs is also lower than in healthy speakers (whereas it is normal for the nonfinite lexical verbs).

Sentence Completion Test

The results of the experiment are given in Table 6. Completing a matrix clause was more difficult than completing an embedded clause, \(t = -2.79, df = 5, p <\)

\(^7\) Because the figures of the spontaneous speech analysis are proportional, Mann–Whitney U tests have been used for statistical testing.
TABLE 6
The Individual Results of the Experiment to Completion of Matrix (+movement) and Embedded (−movement) Clauses

<table>
<thead>
<tr>
<th>Correct</th>
<th>Errors matrix clause</th>
<th>Errors embedded clause</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Matrix</td>
<td>Embedded</td>
</tr>
<tr>
<td>B15</td>
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<td>B20</td>
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<td>14</td>
</tr>
<tr>
<td>Mean</td>
<td>8.50</td>
<td>12.33</td>
</tr>
</tbody>
</table>

This holds for all patients with one exception (B16). The outlier is the patient who is most severely aphasic.

The error analysis shows that in the matrix clauses, one error type is most prominent: producing the embedded word order, that is, producing the object followed by the (finite) verb in its base-generated position. The opposite, a finite verb in the second position in the embedded clause, is hardly ever produced except by the patient who shows a deviant pattern overall (B16).

Another frequent error, made by 3 of the patients, is omission of the verb in the matrix clause. Actually, this results in a grammatical sentence because in Dutch, as in English, in coordinating sentences the repeated verb may be left out: This man cuts the tomato and this man ____ the bread (this is not grammatical in an embedded clause: *This is the man who cuts the tomato and this is the man who ____ the bread). Nevertheless, this was counted as an error for two reasons. First, none of the control subjects (neither child nor adult) left out the verb. Second, none of the patients omitted the verb all of the time, meaning that they were aware that they should use it (as was clear from their reactions).

In summary, sentence completion with a finite verb and an object is more difficult in matrix clauses than in embedded clauses; in other words, it is more difficult when the finite verb has been moved from its base-generated position to the verb-second position. The most frequent error is failure to move the finite verb, followed by omission of the verb.

DISCUSSION

The data from the spontaneous speech analysis confirm the results from our earlier studies. Bastiaanse and Jonkers (1998) showed that in Dutch agrammatic spontaneous speech, both the lexical diversity and the proportion of finite clauses were diminished. The current study shows that this conclusion was too general; it is not the diversity of lexical verbs in general that is diminished but only the diversity of the finite lexical verbs. When the agrammatic aphasics do produce a finite verb, it is most often a modal or copula. The finite lexical verbs stem from a relatively small database that the agrammatic Broca’s aphasics use in this condition. Nonfinite verbs are much easier to retrieve; agrammatic Broca’s aphasics produce them relatively often, and the diversity is not significantly lower than normal. It is important, however, to make a distinction within the class of nonfinite verbs here: Infinitives are produced more often, and participles less often, than they are in the speech of non-brain-damaged
speakers. What is remarkable is the high number of copulas and modals produced by the patients; these words belong to the class of “function words”. This phenomenon of a relatively normal production of highly frequent finite verbs has also been mentioned by Berndt, Mitchum, Haendiges, and Sandson (1997) for English-speaking agrammatics. Agrammatic Broca’s aphasics are supposed to omit function words, as can be found in the most often cited definitions of telegraphic speech (Caramazza & Berndt, 1985; Saffran et al., 1989). This shows that the distinction “function word–content word” fails to describe the telegraphic speech of Broca’s aphasics. Telegraphic speech should therefore be defined not in broad categories, such as function words and content words, but rather in grammatical (i.e., syntactic) terms.

There is no difference in the frequency of the verbs produced by the agrammatic Broca’s aphasics and the non-brain-damaged speakers. If these aphasics suffer from retrieval problems for verbs, as is often suggested in the literature (e.g. Cheng & Bates, 1998; Miceli, Silveri, Villa, & Caramazza, 1984; Zingeser & Berndt, 1990), then a frequency effect might be expected. Although a frequency effect has often been shown for retrieval deficits for nouns, it has been mentioned before that such an effect for verbs does not exist (see, e.g., Jonkers, 1998).

The data of the experiment demonstrate that the previous finding—that moved finite verbs are more difficult to produce than base-generated finite verbs—was not due to an artifact. Production of an object–finite verb string, in which the finite verb is in the base-generated position, is easier than production of a finite verb–object string, in which the verb has been moved to the second position in the clause. Notice that this also means that producing a finite verb and object in an embedded clause is easier than in the far more frequently used matrix clause. We would therefore like to suggest that the problems that the Dutch agrammatic Broca’s aphasics encounter with the production of finite verb are due to problems with a syntactic movement rule, that is, verb second in the Dutch matrix clause.

The errors that are produced in the experiment are interesting. First, let us examine the verb omissions in the matrix clauses. As said above, these resulted in grammatical gapping constructions, but these were never used by the children or the non-brain-damaged speakers, and we therefore counted them as errors. The patients themselves also indicated that they realized that these were not the correct answers.

The errors in which a finite verb was produced at the end of the matrix clause were unexpected, that is, the embedded word order with a nonmoved verb. (Notice that the opposite pattern, a finite verb in the second position in the embedded clause, is produced more than once only by the patient [B16] who shows the deviant pattern.) This is quite remarkable given that Dutch agrammatics never produce this construction (object–finite verb in a nonembedded clause) in their spontaneous speech; when they do not move the verb in spontaneous speech, they always produce a nonfinite form, either the infinitive or the participle (see Bastiaanse & Van Zonneveld, 1998, and the analysis above). What they are doing in the experiment is producing a finite verb but failing to move it to the verb-second position. An explanation for this might be that in coordinating sentences, the two clauses should agree with respect to finiteness. This holds both for Dutch and for English. To the question in (4a), two answers are possible: (4b) is a coordination of two nonfinite elliptical clauses and (4c) a coordination of two finite clauses. Both are grammatical sentences. In (4d), however, the rule of similarity with respect to finiteness is violated, and therefore the sentence in ungrammatical.

8 This phenomenon, a nonmoved finite verb in the final position in the matrix clause, has also been reported in the spontaneous speech of Dutch children (Wexler, Schaeffer, & Bol, 1999). A nonfinite verb in the verb-second position has never been observed, neither in the speech of children nor in the present data of the experiment discussed in this article.
(4a) Wat zijn zij aan het doen?
What are they doing?
(4b) Jan lezen en Piet televisie kijken
John reading and Pete watching television
(4c) Jan leest en Piet kijkt televisie
John reads and Pete watches television
(4d) *Jan leest en Piet televisie kijken
*John reads and Pete watching television

An explanation for the errors of the agrammatic speakers could be that they cannot apply verb second. However, if they complete the sentence, deze jongen snijdt de tomaat en deze jongen . . . (this boy cuts the tomato and this boy . . .), with a nonfinite verb, as in tomaat eten (eating tomato), then the result is a violation of the mentioned finiteness agreement in coordinating sentences. It seems as though the agrammatic speakers do not violate this rule; rather, they violate the rule that finite verbs in the matrix clause belong in the second position.

All in all, the spontaneous speech analysis shows that Dutch agrammatic Broca’s aphasics produce relatively few finite clauses. The finite lexical verbs they do produce show little variety compared to those of non-brain-damaged people. The diversity of the nonfinite verbs is normal, and so is the frequency of both the finite and nonfinite lexical verbs. The problems with the production of moved finite verbs are more prominent in this experiment, finite verbs are more difficult to produce in verb second than in the base-generated position. Taken together these two studies demonstrate that the problems with verbs in the spontaneous speech of Dutch agrammatic Broca’s aphasics are restricted to finite verbs, that is, those verbs that have been moved from their base-generated position.

CONCLUSION

Dutch agrammatic Broca’s aphasics have difficulty producing moved verbs. In the sentence completion test, there is a significant discrepancy between moved and nonmoved finite verbs, and in spontaneous speech, verb movement interferes with lexical retrieval of verbs; the diversity of the moved verbs is significantly lower than in non-brain-damaged speakers, whereas there is no significant difference for the diversity of the nonmoved verbs. Because verb movement is a language-specific operation, this relation between lexical retrieval and verb finiteness might be restricted to languages that have overt verb movement. According to our suggestions above—problems with verbs in spontaneous speech are caused by failure to produce moved verbs—one expects no problems in the production of finite verbs in languages without overt verb movement, but the literature shows that at least in English, such problems do exist (see, e.g., Canaha-Amatay, 1997; Saffran et al., 1989; Thompson et al., 1995). Preliminary results of the test mentioned in Bastiaanse and Van Zonneveld (1998) in Russian (Avrutin & Bastiaanse, in preparation) and the test used for the current study in English (Thompson & Bastiaanse, in preparation) show that these agrammatic Broca’s aphasics do have problems with the production of finite verbs but that the discrepancy between matrix and embedded clauses is not present in those languages. This implies that the differences found in Dutch matrix and embedded clauses are due to verb movement, but it also means that there is more at stake than verb movement. This is not surprising because even though the Dutch agrammatic Broca’s aphasics are worse in the matrix than in the embedded clauses, they do make
errors in the latter as well. Right now, it is unclear what the other problem(s) might be. It is not likely that it is lexical retrieval, as most of the time the correct lexical entry is produced and the patients are prompted with the verb three times per item.

So far, we know that verb movement is a difficult operation for Dutch agrammatic Broca’s aphasics and that it interferes with lexical retrieval. This, however, cannot be the only deficit in the production of finite verbs in Broca’s aphasia, as problems with finite verbs also occur in languages that are not supposed to have verb movement. Future cross-linguistic research may show what else plays a role in the production of finite verbs in agrammatic Broca’s aphasia.

APPENDIX A

1. Deze jongen snijdt de tomaat en deze jongen snijdt het brood; dit is de jongen die de tomaat snijdt en dit is de jongen die . . .
2. Dit is de vrouw die de jongen groet en dit is de vrouw die het meisje groet; deze vrouw groet de jongen en deze vrouw . . .
3. Dit meisje omhelst de man en dit meisje omhelst de vrouw; dit is het meisje dat de man omhelst en dit is het meisje dat . . .
4. Dit meisje gooit de stok en dit meisje gooit de bal; dit is het meisje dat de stok gooit en dit is het meisje dat . . .
5. Dit is de vrouw die de trui breit en dit is de vrouw die de sok breit; deze vrouw breit de trui en deze vrouw . . .
6. Deze hond krabt de vrouw en deze hond krabt de man; dit is de hond die de vrouw krabt en dit is de hond die . . .
7. Dit is het meisje dat de hond ziet en dit is het meisje dat de kat ziet; dit meisje ziet de hond en dit meisje . . .
8. Deze jongen aait de hond en deze jongen aait de kat; dit is de jongen die de hond aait en dit is de jongen die . . .
9. Dit is de man die de krant leest en dit is de man die het boek leest; deze man leest de krant en deze man . . .
10. Deze vrouw bekijkt de clown en deze vrouw bekijkt de politieagent; dit is de vrouw die de clown bekijkt en dit is de vrouw die . . .
11. Dit is het meisje dat de appel eet en dit is het meisje dat de banaan eet; dit meisje eet de appel en dit meisje . . .
12. Dit is de vrouw die de hond filmt en dit is de vrouw die de man filmt; deze vrouw filmt de hond en deze vrouw . . .
13. Dit meisje tekent het huis en dit meisje tekent de bloem; dit is het meisje dat het huis tekent en dit is het meisje dat . . .
14. Dit is de man die melk drinkt en dit is de man die wijn drinkt; deze man drinkt melk en deze man . . .
15. Dit is de hond die de vrouw volgt en dit is de hond die de man volgt; deze hond volgt de vrouw en deze hond . . .
16. Deze vrouw breit de sok en deze vrouw breit de trui; dit is de vrouw die de sok breit en dit is de vrouw die . . .
17. Dit is de jongen die de man omhelst en dit is de jongen die de vrouw omhelst; deze jongen omhelst de man en deze jongen . . .
18. Deze man filmt de hond en deze man filmt de vrouw; dit is de man die de hond filmt en dit is de man die . . .
19. Dit is de kat die de man krabt en dit is de kat die de vrouw krabt; deze kat krabt de man en deze kat . . .
20. Dit is de vrouw die de tomaat snijdt en dit is de vrouw die het brood snijdt; deze vrouw snijdt de tomaat en deze vrouw . . .
21. Dit meisje leest de krant en dit meisje leest het boek; dit is het meisje dat de krant leest en dit is het meisje dat . . .
22. Deze kat volgt de vrouw en deze kat volgt de man; dit is de kat die de vrouw volgt en dit is de kat die . . .
23. Deze jongen ziet de kat en deze jongen ziet de hond; dit is de jongen die de kat ziet en dit is de jongen die . . .
24. Deze man groet de jongen en deze man groet het meisje; dit is de man die de jongen groet en dit is de man die . . .
25. Dit is het meisje dat de kat aait en dit is het meisje dat de hond aait; dit meisje aait de kat en dit meisje . . .
26. Deze vrouw drinkt wijn en deze vrouw drinkt melk; dit is de vrouw die wijn drinkt en dit is de vrouw die . . .
27. Dit is de man die de clown bekijkt en dit is de man die de politieagent bekijkt; deze man bekijkt de clown en deze man . . .
28. Dit is de jongen die de bal gooit en dit is de jongen die de stok gooit; deze jongen gooit de bal en deze jongen . . .
29. Deze jongen eet de appel en deze jongen eet de banaan; dit is de jongen die de appel eet en dit is de jongen die . . .
30. Dit is de jongen die het huis tekent en dit is de jongen die de bloem tekent; deze jongen tekent de huis en deze jongen . . .

*English translation*

1. This boy cuts the tomato and this boy cuts the bread; this is the boy that cuts the tomato and this is the boy that . . .
2. This is the woman that greets the boy and this is the woman that greets the girl; this woman greets the boy and this woman . . .
3. This girl hugs the man and this girl hugs the woman; this is the girl that hugs the man and this is the girl that . . .
4. This girl throws the stick and this girl throws the ball; this is the girl that throws the stick and this is the girl that . . .
5. This is the woman that knits the sweater and this is the woman that knits the sock; this woman knits the sweater and this woman . . .
6. This dog scratches the woman and this dog scratches the man; this is the dog that scratches the woman and this is the dog that . . .
7. This is the girl that sees the dog and this is the girl that sees the cat; this girl sees the dog and this girl . . .
8. This boy pets the dog and this boy pets the cat; this is the boy that pets the dog and this is the boy . . .
9. This is the man who reads the newspaper and this is the man that reads the book; this man reads the newspaper and this man . . .
10. This woman watches the clown and this woman watches the cop; this is the woman that watches the clown and this is the woman that . . .
11. This is the girl that eats the apple and this is the girl that eats the banana; this girl eats the apple and this girl . . .
12. This is the woman that films the dog and this is the woman that films the man; this woman films the dog and this woman . . .
13. This girl draws the house and this girl draws the flower; this is the girl that draws the house and this is the girl that . . .
14. This is the man that drinks milk and this is the man that drinks wine; this man drinks milk and this man . . .
15. This is the dog that follows the woman and this is the dog that follows the man; this dog follows the woman and this dog . . .
16. This woman knits the sock and this woman knits the sweater; this is the woman that knits the sock and this is the woman that . . .
17. This is the boy that shoves the man and this is the boy that shoves the woman; this boy shoves the man and this boy . . .
18. This man films the dog and this man films the woman; this is the man that films the dog and this is the man that . . .
19. This is the cat that scratches the man and this is the cat that scratches the woman; this cat scratches the man and this cat . . .
20. This is the woman that cuts the tomato and this is the woman that cuts the bread; this woman cuts the tomato and this woman . . .
21. This girl reads the newspaper and this girl reads the book; this is the girl that reads the newspaper and this is the girl that . . .
22. This cat follows the woman and this cat follows the man; this is the cat that follows the woman and this is the cat that . . .
23. This boy sees the cat and this boy sees the dog; this is the boy that sees the cat and this is the boy that . . .
24. This man greets the boy and this man greets the girl; this is the man that greets the boy and this is the man that . . .
25. This is the girl that pets the cat and this is the girl that pets the dog; this girl pets the cat and this girl . . .
26. This woman drinks wine and this woman drinks milk; this is the woman that drinks wine and this is the woman that . . .
27. This is the man that watches the clown and this is the man that watches the cop; this man watches the clown and this man . . .
28. This is the boy that throws the ball and this is the boy that throws the stick; this boy throws the ball and this boy . . .
29. This boy eats the apple and this boy eats the banana; this is the boy that eats the apple and this is the boy that . . .
30. This is the boy that draws the house and this is the boy that draws the flower; this boy draws the house and this boy . . .

APPENDIX B

<table>
<thead>
<tr>
<th></th>
<th>Verb–Finite = V2</th>
<th>Verb–Finite ≠ V2</th>
<th>Verb–Nonfinite = Final</th>
<th>Verb–Nonfinite ≠ Final</th>
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<td>1, 2^a</td>
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</tr>
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<td>—</td>
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<td>—</td>
</tr>
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</tr>
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<td>26</td>
<td>4^a</td>
<td>10</td>
<td>1^b</td>
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</table>

244 2(9)^a 119 2(13)^a

Note. Table shows position of the finite and nonfinite verbs in the utterances of the agrammatic speakers. V2, verb-second position; Final, clause-final position.
^a These finite verbs are in the embedded clause, so the final position is the correct position.
^b These are not in the verb-second position but are (legally) followed by an adjunct.
## APPENDIX C

<table>
<thead>
<tr>
<th></th>
<th>B1</th>
<th>B2</th>
<th>B6</th>
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*Note.* Table shows the raw numbers of the verb forms produced by the agrammatic speakers.

## APPENDIX D

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*Note.* Table shows the raw numbers of the verb forms produced by non-brain-damaged speakers.
REFERENCES


